Hospital Efficiency In Turkey: Metafrontier Analysis

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Abstract

Turkey has the highest health spending on hospitals within OECD. Therefore measuring efficiency of hospitals is crucial to improve the health care. In line with this purpose Turkey experienced major reforms in healthcare since 1980s'. This paper focuses on the healthcare system for the Aegean Region of Turkey. The data obtained from Health Statistics Yearbook 2007 and our data covers 135 hospitals. Because of the heterogeneity across hospitals we used DEA Meta frontier analysis. The results show that the technical efficiencies with respect to group frontier and meta-frontier training-research hospitals and the medical faculty hospitals are higher than state and private hospitals. The results also indicate that the variation of technology gap ratio (TGR) is high for training-research hospitals and the medical faculty hospitals. Furthermore TGR for private and state hospitals are high and close to each other.

Keywords: Hospital, Turkey, Efficiency, Metafrontier

Introduction

The quality of health services is one of the important factors which affects the quality of life of individuals or communities. As a result of which, important policy changes in health services are made in most countries also in Turkey, and the quality of health services is tried to enhance. Turkey experienced major reforms in healthcare since 1980s', and health system of Turkey had a big transformation. The mentioned Health Transformation Programme aimed to improve the quality and decentralized health system and benefited from these challenges. As a result of this programme, the average life expectancy was 61.4 and increased to 75.4. (www.worldlifeexpectancy.com), and the population ages 15-64 became 67.5% of total population. As the number of elder population increases, the pressure on the financing health care also increases. Therefore the finance of the health care system is effectuated through General Health Care Insurance.

Though occurred improvements in health sector, the key issue is the efficiency of the hospitals which are the main actor of the health sector. The main factor which determines the efficiency of the hospitals is the applied health policies. There have been some studies on the importance of the efficiency of the hospitals. Gülsevin and Türkan (2012), Gülcü et al..(2004), Bal and Bilge (2013), Temür and Bakırcı (2008), Tetik (2003), Aslan and Mete (2007), Yeşilyurt and Yeşilyurt (2007), Bayraktutan and Pehlivanoğlu (2012), Yeşilyurt (2007a), Doğan and Gencen (2014), Yeşilyurt (2007b) and Yeşilyurt and Yeşilyurt (2006) had measured the efficiency of hospitals in Turkey, and DEA is used to measure the efficiency in these studies. The main assumption of DEA is that the decision making units (hospitals) have homogeneous structure. A considerable amount of research has been made about the measurement of the efficiency of hospitals, but there is not any study accounting for the heterogeneity across hospitals. In this study, the differences across the hospitals are discussed by using metafrontier analysis. The metafrontier approach allows to define different frontier for each group, and the efficiency is measured in reference to the groups and the metafrontier. Furthermore, by using the mentioned approach Technology Gap Ratio (TGR) can be defined to compare the relative efficiency levels of hospitals.

The rest of the paper is organized as follows. In the next section, we describe methodologies to be used. Then the data for the empirical analysis are introduced. Section four, presents and discusses the empirical results obtained from the metafrontier approach. Finally section five, concludes the paper.

Methodology

Data Envelopment Analysis (DEA) is widely used method to measure efficiency levels across hospitals. Although DEA is famous method, it has some drawbacks. One of most important drawback of common DEA is that all DMUs are assumed homogeneous. If this assumption is not valid, measured efficiency score can be biased. To avoid this problem, we employed metafrontier approach, developed by Battese and Rao (2002) and O'Donnell *et al*.(2008) in this study. Metafrontier approach is to account for heterogeneity across hospitals and contains the calculation of efficiency with respect to metafrontier and frontiers of homogeneous group which represent the common and the group specific technologies.

Assumed that there are k homogeneous group (in this study hospitals are classified into three groups as state hospitals, private hospitals and training-research and medical faculty hospitals) and technology set of each group can be described as combination of efficient production possibilities (Battese *et al.* 2004).

$$T^k = \{(x, y) \in R_+ | \; x \; can \; produced \; y\} \quad (1)$$

In equation 1, x denotes nonnegative input vectors y denotes nonnegative output vectors and T denotes the technology set. According to this approach, meta frontier can be described as a function which envelops different group frontiers. And this different group frontiers has different technology and factor levels. In this circumstances, meta technology set can be written as below equation.

$$T^* = \left\{ \begin{matrix} (x, y): x \geq 0 \; and \; y \geq 0, such \; that \; x \; can \; produce \; y \; in \\ at \; least \; one \; group \; technology, T^1, T^2, \ldots, T^k \end{matrix} \right\} \quad (2)$$

It is assumed that T^* satisfies all production axioms, so technical efficiency can be measured by using distance function related to meta technology set. The relationship between meta frontier and group frontier is illustrated in Figure 1.

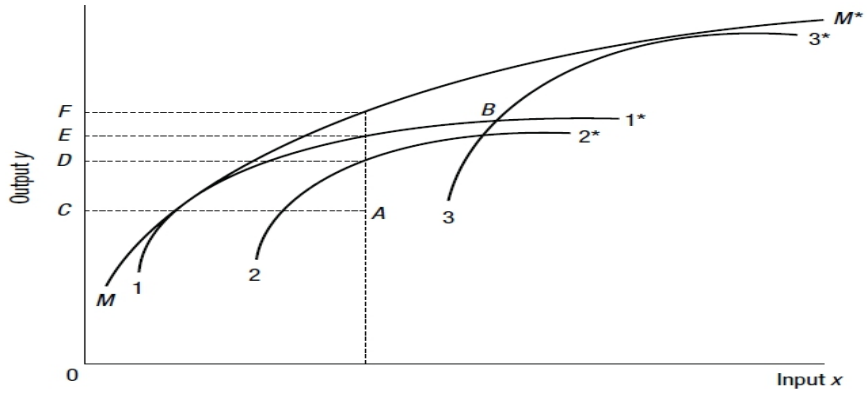

Figure 1: Metafrontier and group frontier
Source: O'Donnell et al. 2008: 236

According to Figure 1 and above explanations, technical efficiency with respect to group frontier and technical efficiency with respect to meta frontier can be written as follow respectively.

$$TE^k = D_0(x, y) = inf_\theta\{\theta > 0: (y/\theta) \in P^k(x)\} \quad (3)$$

$$TE^* = D_0^*(x, y) = inf_\theta\{\theta > 0: (y/\theta) \in P^*(x)\} \quad (4)$$

These equations show the maximum degree to which a given output vector can be increased and still within the production possibility set. Due to the fact that meta frontier envelopes all group frontiers shown in Figure 1, output distance function of group frontier should be greater than or equal to output distance function of meta frontier. After the measure of technical efficiency, Technology Gap Ratio (TGR) which measure the gap between group and meta frontier can be obtain like this.

$$TGR_0^k(x, y) = \frac{D_0^*(x,y)}{D_0^k(x,y)} = \frac{TE_0^*(x,y)}{TE_0^k(x,y)} \quad (5)$$

TGR has values between zero and one and this ratio indicate that for a given input vector, potential output of the group frontier is a certain percentage of the potential output defined by the meta frontier (Tunca *et al.* 2013).

Data

In this study 135 hospitals have been analyzed for the Aegean Region of Turkey. The data on hospitals obtained from Health Statistics Yearbook 2007. The number of doctors and beds are used as input, the number of surgery, operations, outpatients, inpatients and inpatient days are used as output. All variable used in this study are expressed per ten thousand head. Due to the heterogeneous structure, we split the data into three groups. The first group contains State hospitals, the second group consists of private hospitals and the third group contains Training- research hospitals and medical faculty hospitals. In each group there are 81, 39 and 15 hospitals, respectively.

Descriptive statistics of all variable is shown in Table 1.

Table 1: Descriptive Statistics

		doctor	bed	surgery	outpatient	operation	inpatient	inpatient days
state hospital	Mean	0,4283	1,7940	3070,8908	83,2711	43,3356	84,6881	359,4786
	Std.Dev.	0,5599	2,9942	4166,4525	146,1249	76,0593	148,6359	612,1063
	Min	0,0160	0,0695	174,0328	1,3585	0,1667	1,2109	4,2761
	Max	4,0405	23,4949	31411,8492	1115,4842	501,2945	1130,8266	4254,6728
private hospital	Mean	0,1859	0,3309	411,1964	24,6413	15,4860	24,9931	47,1846
	Std.Dev.	0,1444	0,2785	425,3347	20,8896	15,9823	21,1976	41,9332
	Min	0,0080	0,0267	2,8481	0,6418	0,3182	0,6383	0,8986
	Max	0,4960	1,2269	1984,2297	90,8715	72,7082	91,6145	148,7802
Training-research hospital	Mean	1,6725	2,2714	1763,9727	102,6172	89,9344	104,7543	634,8682
	Std.Dev.	1,3124	1,7333	1077,2708	69,4283	84,5878	70,8497	506,8199
	Min	0,0535	0,0294	71,8654	3,0540	2,1581	3,0902	5,5544
	Max	3,5207	6,0721	3686,0120	224,5943	316,1911	228,7878	1598,4674

As observed from Table 1, there is a large difference between the minimum and maximum value for all of the variables. For example, doctor in private hospitals are 2.30 times smaller than state hospitals and 8.99 times smaller than training-research and medical faculty hospitals. Surgery in private hospitals are 7.47 times smaller than state hospitals and 4.29 times smaller than training-research and medical faculty hospitals. All of these explanations clearly observed that each group displays very different characteristic features. If we are to summarize briefly, it can be said that private hospital group has smallest scales than other and training-research hospitals and medical faculty hospitals group have maximum mean value in all variables except surgery.

Results

Estimated average meta and group technical efficiency score are reported in Table 2.

Table 2: Technical efficiency score

	Technical efficiency with respect to group frontier			Technical efficiency with respect to metafrontier		
	State	private	Medical faculty	State	private	Medical faculty
Mean	73,25%	66,06%	94,33%	67,66%	61,22%	76,73%
SD	16,40%	28,49%	9,53%	16,66%	29,23%	14,90%
Min	38,60%	11,79%	68,25%	32,87%	10,33%	42,67%
Max	100,00%	100,00%	100,00%	100,00%	100,00%	99,34%

Source: own calculation

The Training-research hospitals and the medical faculty hospitals are the most efficient hospitals in our study. The average technical efficiency score for this group is 94.33%. This score shows that the training-research hospitals and the medical faculty hospitals are producing 94.33% of the maximum output with respect to the given group technology. Private hospitals have the lowest average technical efficiency scores with 66.06%. The standard deviation is also high for this group and this is indicate that the efficiency scores are widely ranged. Average efficiency scores of state hospitals with respect to group frontier is 73.25% and ranged from 38.60% to 100%. This is show that standard deviation of state hospitals are very high like private hospitals. Although technical efficiency with respect to metafrontier found to be less than group technical efficiency, they support the findings obtained from group frontiers. According to Table 2, training-research hospitals and medical faculty hospitals are producing %76.73 of their potential output with respect to the meta-frontier technology. The remarkable point of these results is about the maximum efficiency scores. The maximum efficiency scores of state and private hospitals are 100% whereas training-research hospitals and medical faculty hospitals are 99.34%. This result yields that state and private hospitals have an important role in identifying the metafrontier. In other terms at least one of the state and private hospitals are on the metafrontier however none of the training-research hospitals and medical faculty hospitals are not.

TGR's of each group represent in Table 3 are also important. While the frontiers of state hospital group and private hospital group are tangent to the metafrontier, the frontier of training-research hospitals and medical faculty hospital is below to the meta-frontier. In the other words, there is gap between metafrontier and training-research hospitals and medical faculty hospitals frontier.

Table 3: TGR of each groups

	Technology Gap Ratio		
	State	Private	Medical faculty
Mean	92,42%	91,18%	81,31%
SD	9,95%	9,75%	13,07%
Min	49,55%	69,72%	42,67%
Max	100,00%	100,00%	99,34%

Source: own calculations

Technology gap ratios (TGR) are presented in Table 3. Even though average technical efficiency of training-research hospitals and medical faculty hospital is the highest, the average TGR of this group is the lowest. We can say that this group could produce about % 81.31 of output that could be produced using the unrestricted meta technology. In addition to this, the highest standard deviation also belongs to this group. This implies that the variation in the TGR is the highest among the training-research hospitals and medical faculty hospitals.

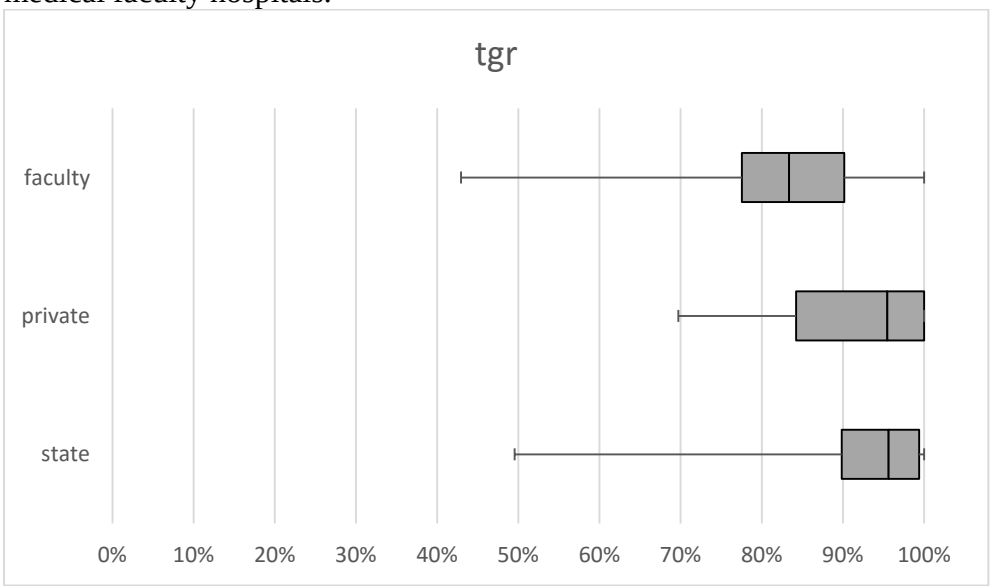

Figure 2: TGR for each group

According to Table 3 and Graph 2, TGR is high and approximately the same for state hospitals and private hospitals. This shows that state hospitals and private hospitals can produce 92.42% and 91.18% of the potential output given the available unrestricted meta technology, respectively. Besides these results private hospitals have more important role for identifying global technology, by virtue of the high standard deviation in state hospitals.

Conclusion

It is aimed in this study at calculating the efficiency of 135 hospitals operating in the Aegean Region. Based on the assumption that the hospitals in the sample constituted a heterogonous structure, they were divided into three groups and the Metafrontier analysis developed by Battese and Rao (2002) was utilized. Thus defining the technological gap ratio, the relative efficiency levels of hospitals and groups were compared.

The findings obtained indicate that training-research hospitals and medical faculty hospitals have the highest efficiency scores both in group frontier and metafrontier. Nevertheless, it is seen that the private hospitals group with the lowest efficiency scores have the highest values of standard deviation. This implies that the efficiency scores of the private hospitals fluctuate within a very wide range. The Technology Gap Ratio (TGR) scores indicate the exact opposite results. The state and private hospital have very high TGR scores whereas the training-research hospitals and medical faculty hospitals have lower TGR scores. It can be understood from this finding that state and private schools play a more important role in defining the global technology in the health sector.

The training-research hospitals and medical faculty hospitals having lower TGR ratios despite higher technical efficiency scores indicate that they lose especially their human capitals to private hospitals in return for high wages. Moreover, state hospitals' corporate identity and strong organizational structures based on their histories caused them to have higher TGR scores. While private hospitals' lower technical efficiency scores imply that they cannot use their own resources rationally or work on a low scale, their higher TGR scores mean both the quality human capital they transfer and the strong technological infrastructure they established.

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